

CLAIMS

1. Apparatus for measuring parameters relating to the trajectory and/or motion of a moving article, the apparatus comprising one or more light sources for providing light emitted from or reflected by the moving article in a known shape or pattern and one or more light sensing means, each light sensing means comprising one or more discrete sensors arranged to provide a signal when illuminated by said light, wherein the field of view of each light sensor or the illumination field of each light source defines a detection plane across the path of the moving article and narrower than the moving article and at least one of the light sensors is arranged to detect when the moving article intercepts a given detection plane, wherever the article intercepts the detection plane, and is arranged to sense variations in the said signal as the article passes through the detection plane and light from or reflected by different parts of the said known shape or pattern is detected, the arrangement being such that the position and orientation of the detection plane relative to a reference point is known or can be deduced from the signal provided by the said at least one light sensor and the position and/or orientation of the article relative to the detection plane can be determined from said variations in the said signal

2. Apparatus as claimed in Claim 1 in which the or each light sensor has a slit shaped aperture and/or a cylindrical lens associated therewith.

3. Apparatus as claimed in Claim 2 in which the light sensor comprises a photo-electric device.

4. Apparatus as claimed in Claim 1 in which the light sensor comprises a linear light sensor and a circular aperture and/or spherical lens associated therewith.

5. Apparatus as claimed in Claim 1 in which the light sensing means comprises a linear light sensor and a slit aperture and/or cylindrical lens associated therewith.

6. Apparatus as claimed in Claim 4 or 5 in which the linear light sensor comprises a linear array of charged couple devices (CCDs).

7. Apparatus as claimed in Claim 4 or 5 in which the linear light sensor comprises an one-dimensional position sensitive detector.

8. Apparatus as claimed in any preceding claim in which the one or more light sources comprise one or more static light emitters for illuminating a reflective portion of the moving article.

9. Apparatus as claimed in any of Claims 1 - 7 in which the one or more light sources comprise one or more light emitters carried by the moving article.

10. Apparatus as claimed in any preceding claim in which the one or more light sources are arranged to provide pulsed light.

11. Apparatus as claimed in any preceding claim in which the detection plane is defined by the sensing means having a relatively wide angle of view in one plane of at least 5 degrees and a relatively narrow angle of view in a perpendicular plane of 1 degree or less and preferably 0.25 degrees or less.

12. Apparatus as claimed in any preceding claim in which the sensing means is arranged to define at least two detection planes.

13. Apparatus as claimed in claim 12 in which the sensing means comprises two light sensors and a single slit aperture and/or a cylindrical lens associated therewith.

14. Apparatus as claimed in claim 13 arranged such that the two detection planes are co-planar and partially overlap.

15. Apparatus as claimed in any preceding claim comprising data processing means for processing signals provided by the said at least one light sensing means.

16. Apparatus as claimed in Claim 15 in which the data processing means is arranged to analyse the form of each signal provided by the light sensing means to determine accurately the timing of the signal.

17. Apparatus as claimed in Claim 15 or 16 in which the data processing means is arranged to analyse the signals from the light sensing means to determine parameters relating to the trajectory and/or motion of the moving article.

18. Apparatus as claimed in any preceding claim having article sensing means for sensing when the moving article is present and activating the light sources and/or light sensing means accordingly.

19. Apparatus as claimed in any preceding claim in combination with one or more articles the movement of which is to be sensed, the or

each of the articles being provided with a reflective portions and/or light emitting means.

20. Apparatus as claimed in Claim 19 in which the article is provided with reflective means comprising a diffusely reflective region surrounded by a relatively non-reflective region.

21. Apparatus as claimed in Claim 20 in which the diffusely reflective region is shaped so as to provide a well-defined maxima in the signal produced by the sensing means when the reflective region passes through a detection plane.

22. Apparatus as claimed in claim 20 in which the diffusely reflective region is shaped so as to enable information on its orientation relative to the detection plane as it passes therethrough to be determined from the signal produced thereby.

23. Apparatus as claimed in Claim 19 in which the article is provided with light emitting means, preferably a light emitting diode, together with a power source therefor.

24. Apparatus as claimed in any preceding claim for use in measuring parameters relating to the trajectory and/or motion of a golf clubhead and/or a golf ball during the execution of a golf shot.

25. Apparatus as claimed in Claim 24 in which the light sensing means are provided in a housing for positioning on the ground at a distance from the tee-off position of the golf ball.

26. Apparatus as claimed in Claim 25 arranged to measure the said parameters when positioned on the ground at a distance of at least 24 cm from the tee-off position.

27. Apparatus as claimed in Claim 25 or 26 in which the housing has a maxima height of 50 mm or less.

28. Apparatus as claimed in Claim 25 comprising two sets of light sensing means provided in respective housings for positioning on the ground at different locations relative to the tee-off position.

29. Apparatus for measuring parameters relating to the position and/or trajectory of a moving article substantially as hereinbefore described with reference to the accompanying drawings.

30. A golf club for use with apparatus as claimed in any preceding claim, the golf club being provided with at least one diffusely reflective region surrounded by a relatively non-reflective region.

31. A golf club as claimed in Claim 30 in which the diffusely reflective region is shaped so when passing through a detection plane, the intensity of light reflected therefrom goes through a well-defined maxima.

32. A golf club as claimed in Claim 30 or 31 in which the diffusely reflective region and/or the relatively non-reflective region are provided thereon by means of a self-adhesive sticker.

33. A golf club for use with apparatus as claimed in any of Claims 1 - 29, the golf club being provided with at least one light emitting

means, preferably a light emitting diode, together with a power source therefor.

34. A golf club substantially as hereinbefore described with reference to the accompanying drawings.

35. Apparatus for measuring the pre-impact and post-impact position and/or motion of a golf clubhead and/or of a golf ball during execution of a golf shot, the apparatus comprising light sensing means having a field of view which comprises at least one detection plane and arranged to sense light reflected from or emitted by the clubhead and/or the ball as it passes through said detection plane.

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